Nikon

Polarizing Microscope

ECLIPSE E400 POL

Instructions

Thank you for purchasing the Nikon products.
This instruction manual is written for the users of the Nikon Polarizing Microscope ECLIPSE E400 POL.
To ensure correct usage, read this manual carefully before operating the instrument.

- It is prohibited to reproduce or transmit this manual in part or whole without Nikon's expressed permission.
- The contents of this manual are subject to change without notice.
- Some of the products described in this manual may not be included in the set you have purchased.
- Although every effort has been made to ensure the accuracy of this manual, if you note any points that are unclear or incorrect, contact your nearest Nikon representative.

Warning/Caution Symbols Used in This Manual

Although Nikon products are designed to provide you with the utmost safety during use, incorrect usage or disregard of the instructions can cause personal injury or property damage. For your safety, read the instruction manual carefully and thoroughly before using the instrument. Do not discard this manual but keep it near the product for easy reference.
In this manual, safety instructions are indicated with the symbols shown below. Be sure to follow the instructions indicated with these symbols to ensure correct and safe operation.

Symbol	Meaning
WARNING	Disregarding instructions marked with this symbol may lead to death or serious injury.
CAUTION	Disregarding instructions marked with this symbol may lead to injury or property damage.

Meaning of Symbols Used on the Equipment

Symbol	Meaning
	Caution for heat. This marking on the lamp cover calls your attention on the following; • Lam cover becomes very hot during and immediately after the illumination. • Risk of burns. Do not touch the lamp cover during and immediately after the illumination. • Make sure that the lamp cover is sufficiently cool before the lamp replacement.

WARNING

1. Intended product use

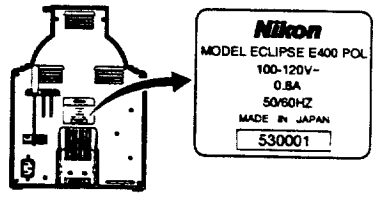
This microscope should only be used for microscopic observation. Do not use it for any other purpose.

2. Do not disassemble

Disassembling may cause malfunction and/or electrical shock. Do not disassemble any parts other than those mentioned in this manual. If you notice any malfunction, notify your nearest Nikon representative.

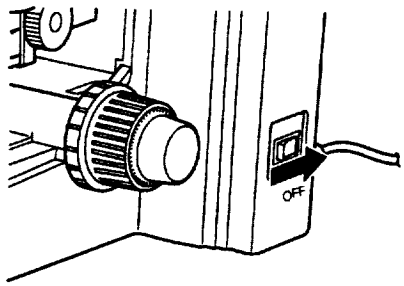
3. Input voltage

Make sure that the input voltage indicated on the back panel of the microscope is the same as your regional voltage. If not the same, do not use the microscope; instead, notify your nearest Nikon representative immediately. If the microscope is used with the wrong input voltage, a short circuit or fire may result, causing the damage of the microscope.



4. Power cord

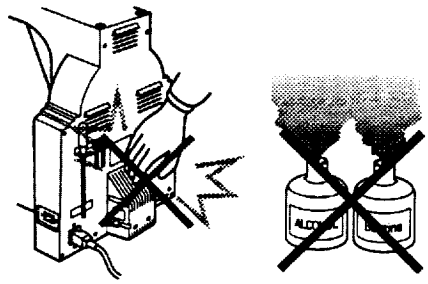
To prevent electrical shock, always turn off the power switch (flip it to the "○" side) before connecting or disconnecting the power cord. Use only the following power supply cord set. Using the wrong power cord could result in damage or fire.



- For 100–120V area
  UL Listed, detachable cord set, 3 conductor grounding type SVT, No. 18 AWG rated at 125V, 7A minimum.
  In case of using the extension cord, use only the power supply cord with the PE (protective earth) wire.
- For 220–240V area
  3 pole power supply cord set, which must be approved according to EU/EN standards.
  Class I equipment should be connected to PE (protective earth) terminal.
  In case of using the extension cord, use only the power supply cord with the PE (protective earth) wire.

5. Heat from the light source

The lamp and the lamp cover become extremely hot. To avoid burns, do not touch the lamp cover while the lamp is lit or for thirty minutes after it has been turned off. Furthermore, in order to avoid the risk of fire, do not place fabric, paper or highly flammable materials such as gasoline, petroleum benzine, paint thinner or alcohol near the lamp cover while it is lit or for about thirty minutes after it has been turned off. The back of the microscope also becomes hot during use. Although this is not a malfunction, be careful not to touch the back of the microscope when it is hot.



⚠ CAUTION

1. **Only use the specified halogen lamp**
   The power supply unit in the microscope provides the power for the halogen lamp that serves as the microscope light source. This unit can supply power for a halogen lamp of up to 6V-30W. The specified lamp must be used, otherwise, the microscope could be damaged.
   Specified lamp: 6V-30W halogen lamp (PHILIPS 5761)

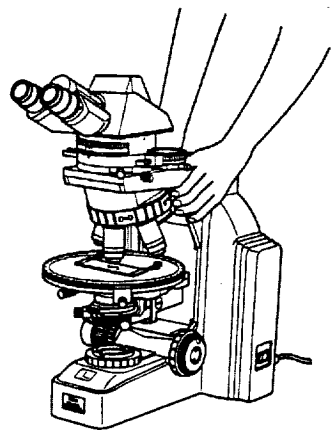
2. **Precautions for replacing the lamp**
   To prevent burns, allow the lamp to cool for at least thirty minutes after turning off the power switch before replacing it. Furthermore, to prevent electrical shock and damage to the microscope, always turn off the power switch (flip it to the "○" side) and unplug the power cord before replacing the lamp.
   After replacing the lamp, be sure to attach the lamp cover securely. Never light the lamp without its cover.

3. **Do not wet the microscope**
   If the microscope gets wet, a short circuit may result that could damage it or make it extremely hot. If you accidentally spill a liquid on the microscope, immediately turn off the power switch (flip it to the "○" side) and unplug the power cord. Then use a dry cloth to wipe away the moisture. If any liquid gets inside the microscope, do not use it; instead, notify your nearest Nikon representative.

4. **Weak electromagnetic waves**
   This microscope emits weak electromagnetic waves. The accuracy of any precision electronic equipment may be adversely affected if positioned too close. If the microscope affects TV or radio reception, move the radio or TV further away from the microscope.

5. **Precautions for installation**
   Be careful not to pinch your hands or fingers when installing the microscope.
   This microscope is a precision optical instrument, and using or storing it under unsuitable conditions may damage it or may have an adverse effect on its accuracy. See "Installation location" on p.28 and always use the microscope in a suitable environment.

6. **Precautions for moving the microscope**
   Securely hold the microscope by the base of the arm from the back.
   Do not grasp the focus knobs, eyepiece tube, stage, etc. when carrying the microscope. This could cause the part to come off, resulting in damage to the microscope.
   Be careful not to hit the lamp cover against the other objects when lifting up or placing the microscope.
   This microscope is a precision optical instrument, so handle it carefully and do not subject it to a strong physical shock. (The accuracy of the objective in particular may be adversely affected by even a weak physical shock.)



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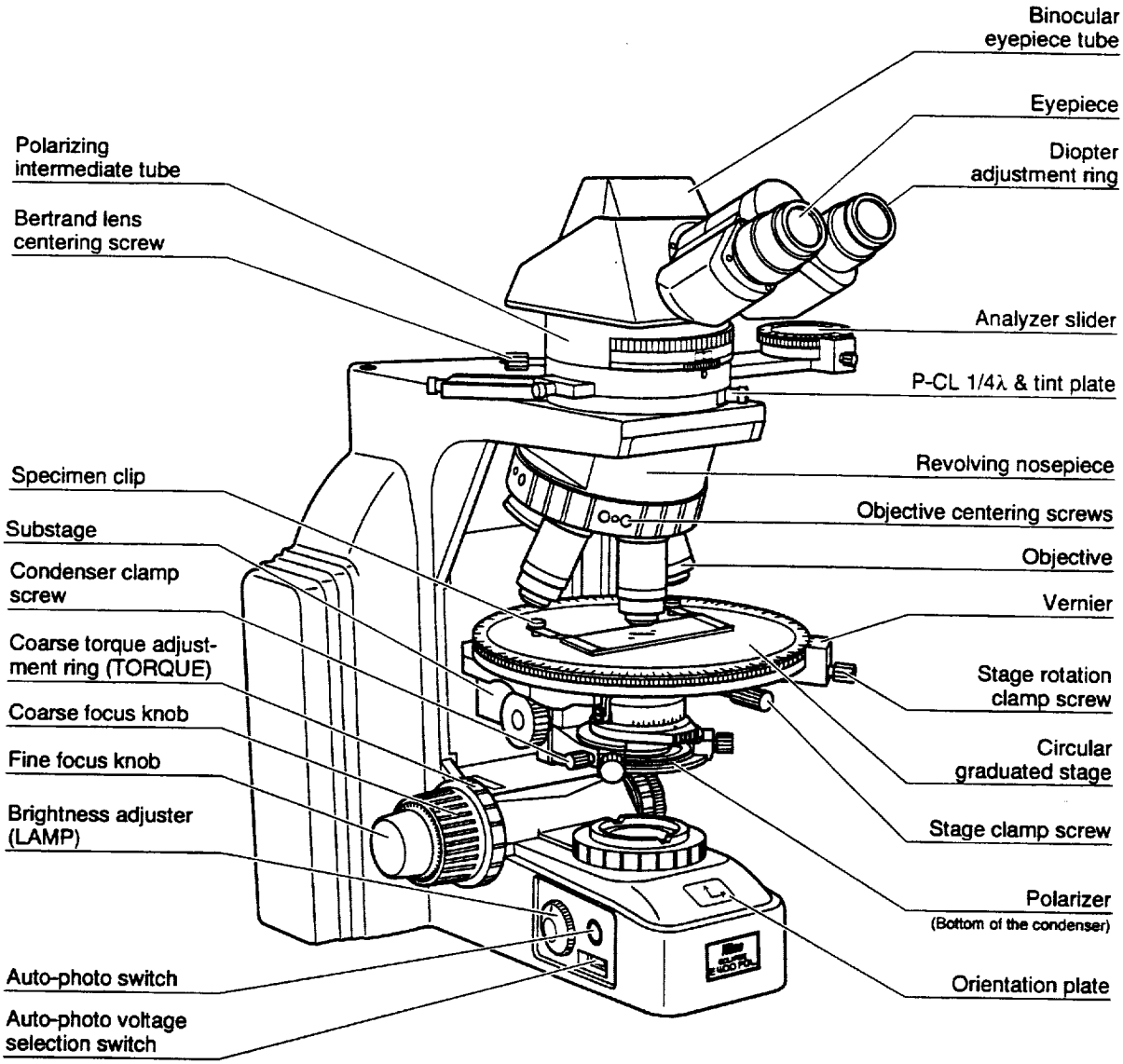
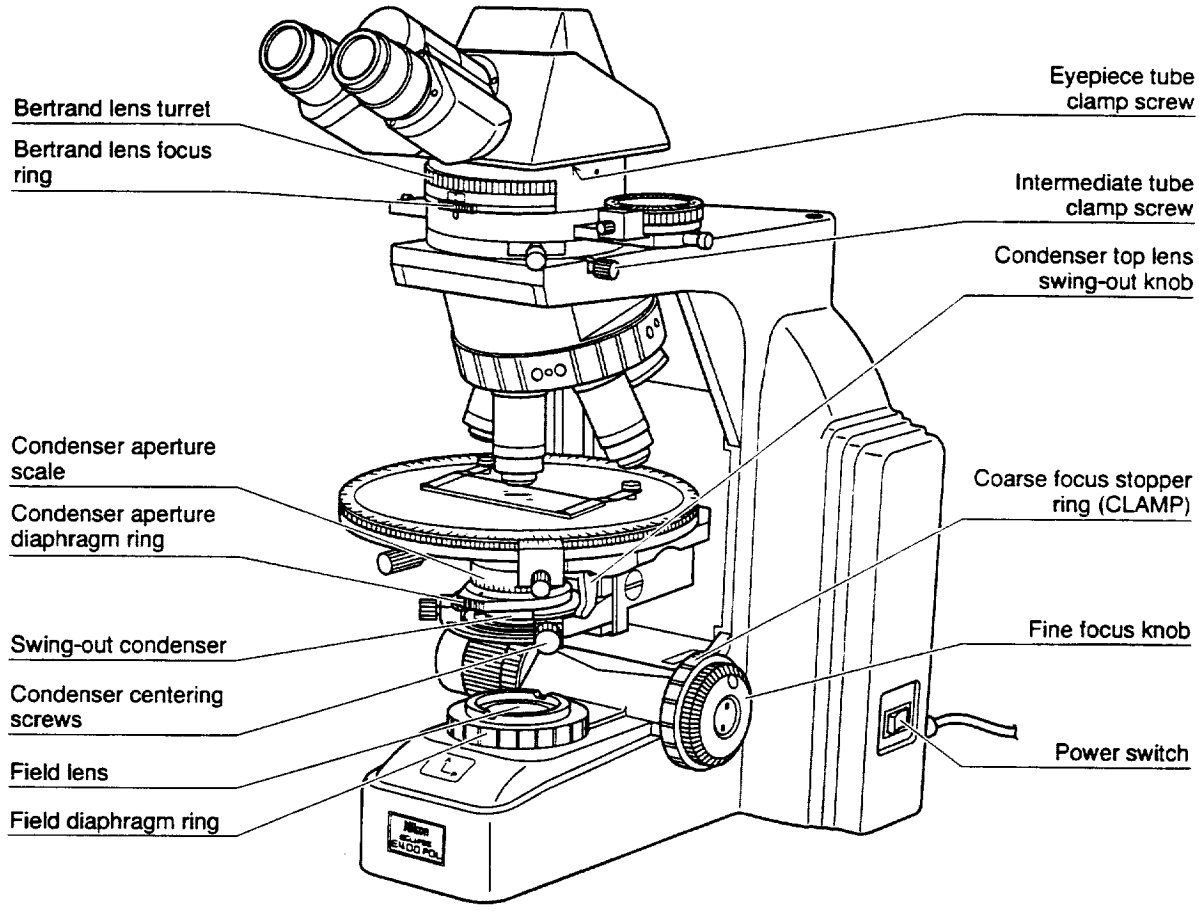
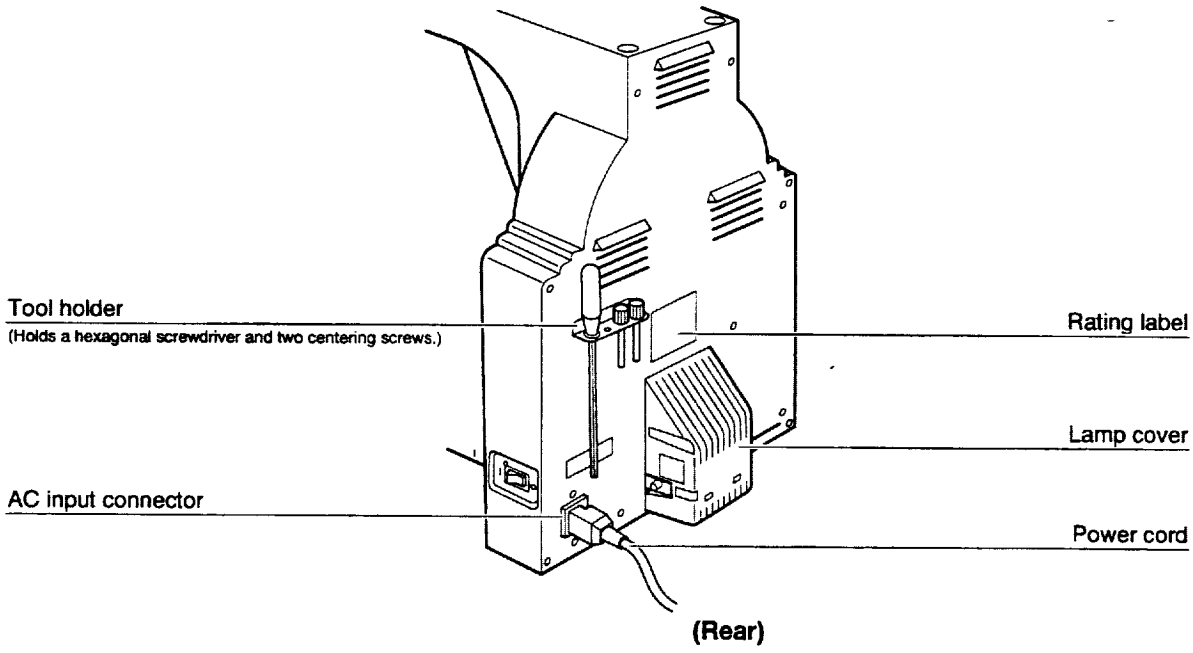
1 Names of Component Parts and Operational Parts

If the microscope has not yet been assembled, see chapter "4. Assembly" first.




Bertrand lens turret
Bertrand lens focus ring
Eyepiece tube clamp screw
Intermediate tube clamp screw
Condenser top lens swing-out knob
Condenser aperture scale
Condenser aperture diaphragm ring
Coarse focus stopper ring (CLAMP)
Swing-out condenser
Fine focus knob
Condenser centering screws
Field lens
Power switch
Field diaphragm ring


Tool holder
(Holds a hexagonal screwdriver and two centering screws.)
Rating label
Lamp cover
AC input connector
Power cord

(Rear)

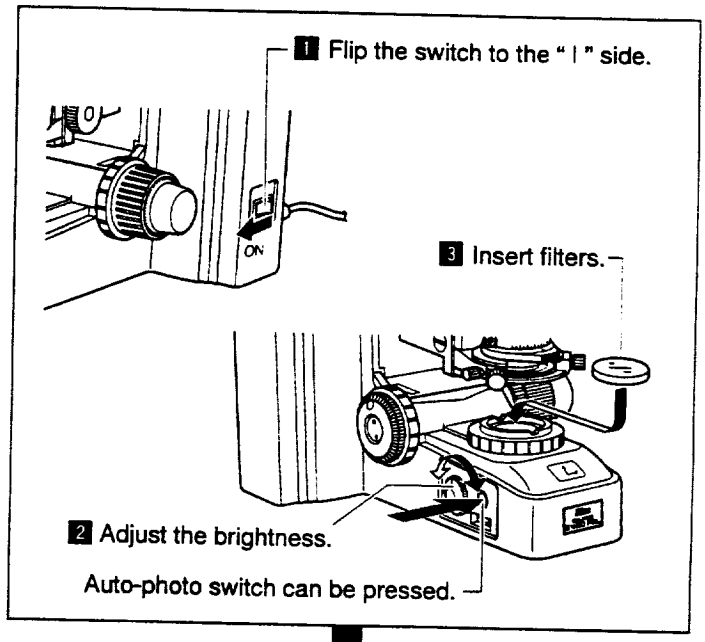
2 Microscopic Procedure

The general procedure for microscopy is described below.
For details on each step, refer to the corresponding item in chapter "3. Operation of Each Part."
If the microscope has not yet been assembled, see chapter "4. Assembly" first.

1 Turn on the power.
(Flip the switch to the " I " side.)
As soon as the power comes on, the switch lights.

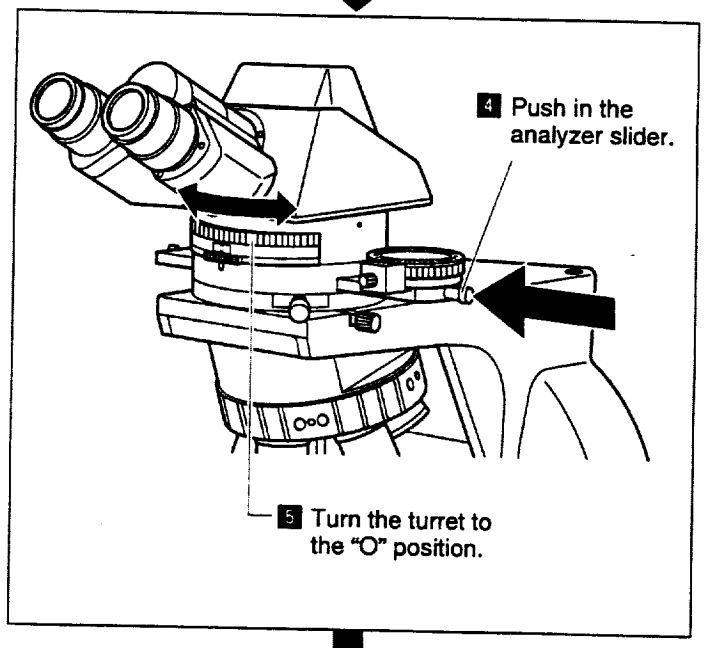
2 Set the brightness adjuster to give the desired brightness.
Pressing the auto-photo switch will set the voltage for the brightness that provides the best color reproduction. (p.21)

3 Insert filters NCB11 into the optical path.
NCB11 improves color reproduction. (p.20)



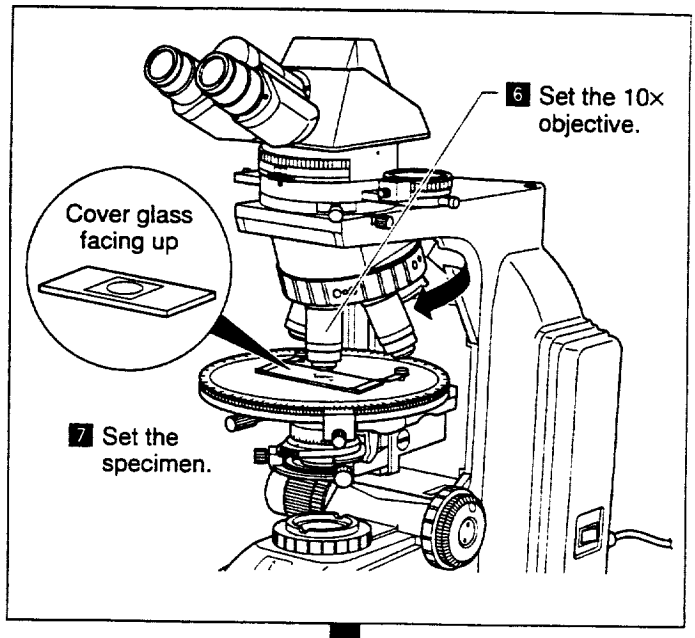
4 Push in the analyzer slider of the intermediate tube to remove the analyzer from the optical path.

5 Put the Bertrand lens turret in the "O" position to remove the Bertrand lens from the optical path.



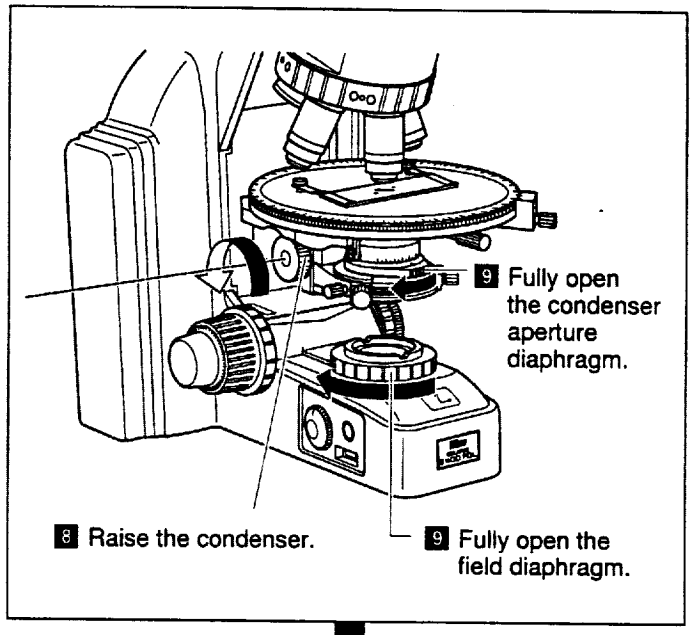
6 Move the 10× objective into the optical path.
Rotate the revolving nosepiece until the 10× objective clicks into place.

7 Set the specimen in place with the cover glass facing up.

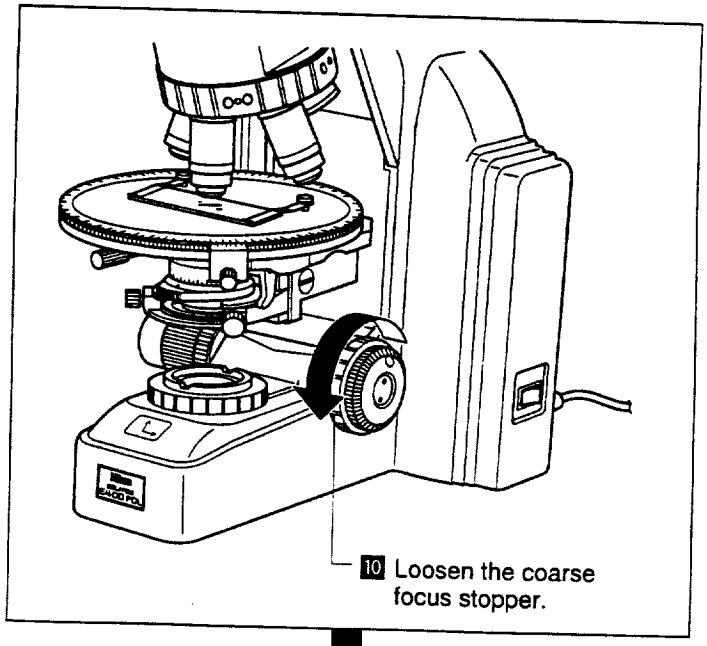


8 Raise the condenser as high as it will go.

9 Fully open the field diaphragm and condenser aperture diaphragm.



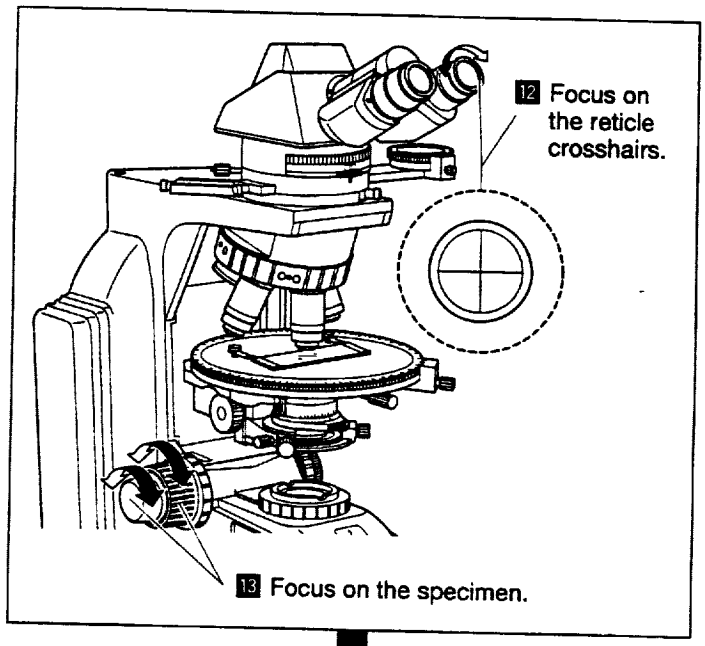
10 Loosen the coarse focus stopper ring.
Rotate it in the direction opposite the arrow on the base as far as it will go. (p.15)



11 Set the optical path to 100% of the binocular eyepiece when using the trinocular eyepiece tube. (p.16)

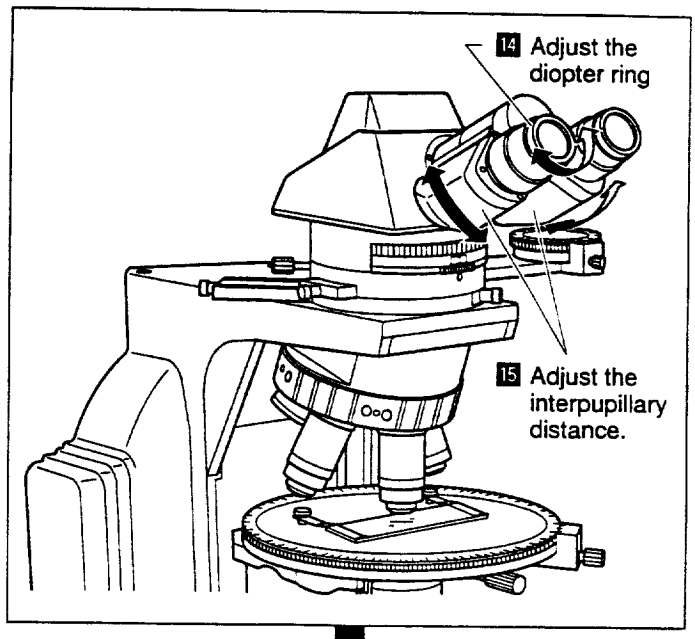
12 Turn the diopter adjustment ring of the right eyepiece (containing the crosshairs) and focus on the crosshairs.

13 Focus on the specimen. (p.14)



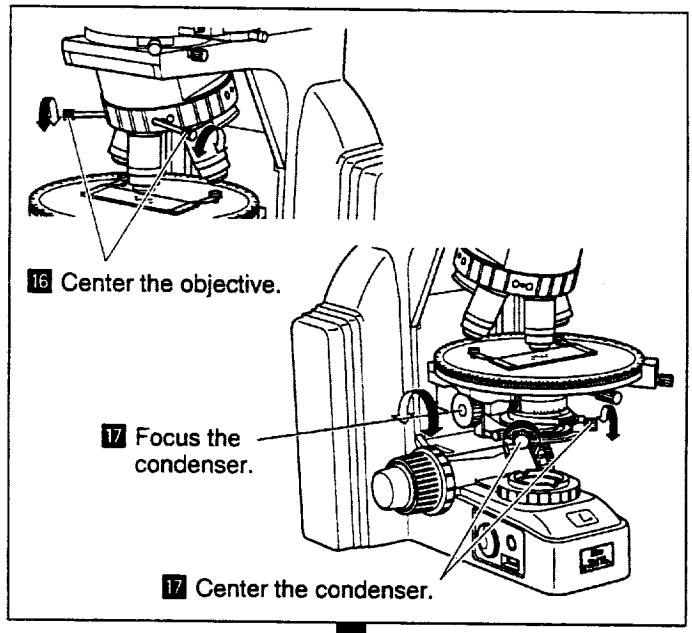
14 Adjust the diopter of the left eyepiece. (p.17)

15 Adjust the interpupillary distance. (p.17)



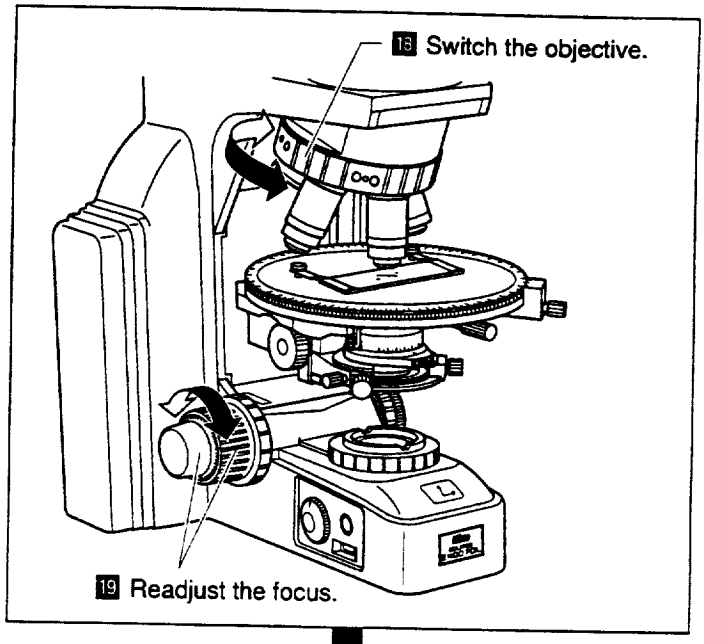
16 Center the objective. (p24)

17 Focus and center the condenser. (p.18)

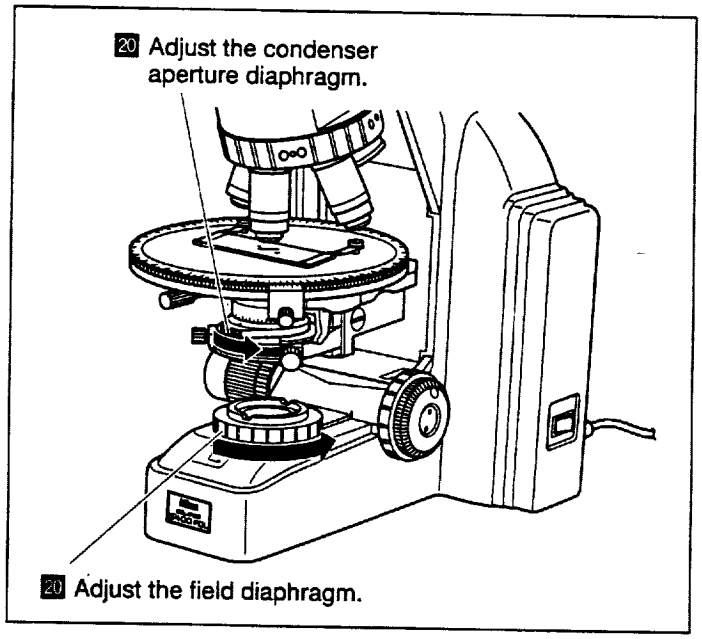


18 Switch to any desired objective and view the specimen.
Rotate the revolving nosepiece to its click-stop position.
In the case of using an oil-immersion objective, apply oil while being careful that air bubbles do not form between the end of the objective and the specimen.

19 Manipulate the coarse focus knob or fine focus knob to re-focus on the specimen.



20 Close the field diaphragm so that it is just outside the field of view. (p.20)
Close the condenser aperture diaphragm to about 70 – 80% of the numerical aperture of the objective. (p.19)



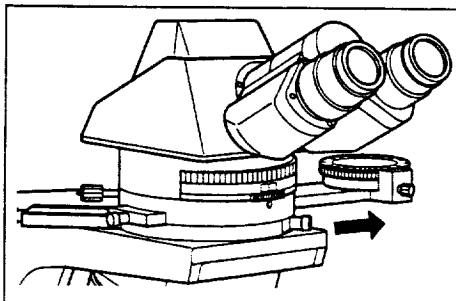
This completes the procedure for microscopy for normal observation. Refer to the following for details regarding the microscopy procedures for "Orthoscopic Observation" and "Conoscopic Observation".

Orthoscopic Observation/Conoscopic Observation

The following provides an explanation of the characteristic observation method of polarizing microscopes along with the microscopy procedure. If normal microscopy has not yet been completed, refer to the previous section and complete normal microscopy.

Orthoscopic Observation

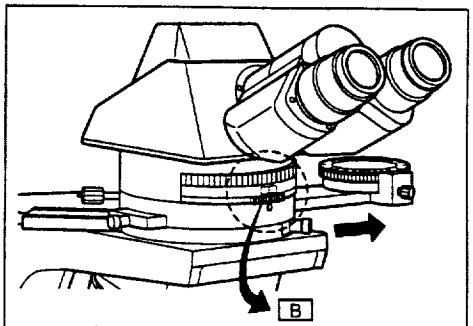
- In this method, the specimen is observed with the polarizer and analyzer placed in the optical path.
- Operation
  Pull out the analyzer slider and move the analyzer into the optical path.
- In this case, the shape of the specimen is visible (direction of optical axis) and the optical properties relative to the direction of the thickness of the specimen can be observed.



Analyzer in the optical path

Conoscopic Observation

- In this method, in addition to the polarizer and analyzer, the Bertrand lens is also moved into the optical path when observing a specimen.
- Operation
  Move the analyzer into the optical path, and place the Bertrand lens turret of the intermediate tube in position "B" to move the Bertrand lens into the optical path. (Refer to p.23 for details regarding the focusing procedure.) Place the P-CL 1/4λ & tint plate in the hollow position. Use an objective having a large numerical aperture (high magnification: normally 40 or higher).
- Specimens can be observed from various angles with diascopic light in the form of a single image. Differing from orthoscopic observation, however, the shape of the specimen itself is not visible with this observation.



Analyzer and Bertrand lens in the optical path

The settings of each part in orthoscopic microscopy and conoscopic microscopy are summarized below.

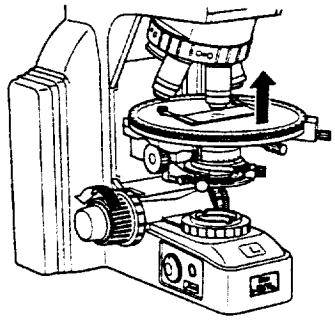
	Orthoscopic Observation		Conoscopic Observation
Purpose of observation	To investigate the vibration direction and birefringence of observation light by observing the extinction and interference color due to the specimen.		To distinguish between uniaxial and biaxial properties and observe the optic-axial angle and optical characteristics in minerals.
Top lens of the condenser	10× or higher	IN	IN
	4× or lower	OUT	
Bertrand lens	OUT (Turret position: O)		IN (Turret position: B)
Aperture diaphragm	10× or higher	70 – 80% of the numerical aperture of the objective	Circumscribed the circumference of the conoscopic field of view (or fully opened)
	4× or lower	Fully opened	
Field diaphragm	10× or higher	Circumscribed the circumference of the eyepiece field of view	Circumscribed the circumference of the orthoscopic field of view
	4× or lower	Fully opened	

Operation of Each Part

1 Coarse and fine focus knobs

1. Rotation of the coarse and fine focus knobs and vertical movement of the stage

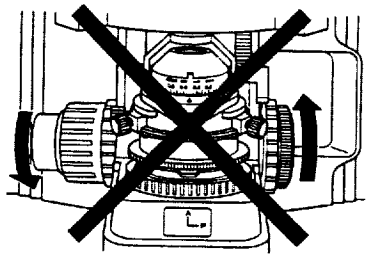
Rotating the fine focus knob one step moves the stage 1 µm.
Rotating the fine focus knob one complete turn moves the stage 0.1 mm.
Rotating the coarse focus knob one complete turn moves the stage 12 mm.
The coarse/fine focus stroke (range of vertical motion) for the stage is 2 mm up and 28 mm down from the reference (focused) position.



Direction of coarse/fine focus knobs and stage vertical motion

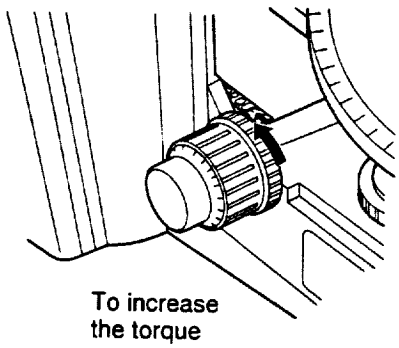
Never attempt either of the following actions. These actions will damage the microscope.

- Rotating the left and right knobs in opposite directions at the same time.
- Continuing to rotate the coarse focus knob after the stage has reached the limit of its motion.



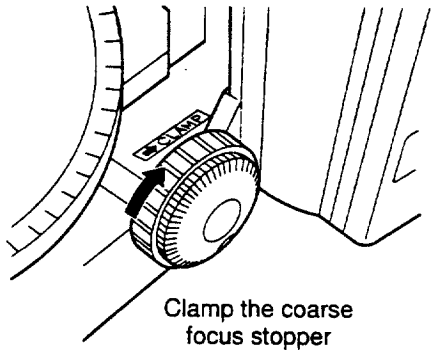
2. Adjusting the torque of the coarse focus knob

It is possible to adjust the torque of the coarse focus knob.
To increase the torque, turn the torque adjustment ring (TORQUE) located behind the coarse focus knob in the direction of the arrow on the microscope base (i.e., the counter-clockwise direction). To reduce the torque, turn the ring in the direction opposite to the arrow (i.e., the clockwise direction).



To increase the torque

3. Coarse focus stopper



Clamp the coarse focus stopper

Purpose of the coarse focus stopper

The coarse focus stopper marks the stage position at which the specimen is in focus by restricting the movement of the coarse focus knob. (Movement of the stage by the fine focus knob is not restricted.)

Once the coarse focus stopper has been clamped in position, the coarse focus knob cannot be used to move the stage any higher. In effect, once the coarse focus knob has been clamped in place at the focus position, a rough focus can be attained the next time simply by turning the coarse focus knob as far as it will go. This feature is convenient when viewing similar specimens one after another.

Using the coarse focus stopper

With the specimen in focus, turn the coarse focus stopper ring as far as it will go in the direction of the arrow on the base of the microscope (about 3/4 revolution). The coarse focus stopper is now clamped in position.

When changing the specimen, lower the stage by turning only the coarse focus knob.

After changing the specimen, gently raise the stage by turning only the coarse focus knob as far as it will go.

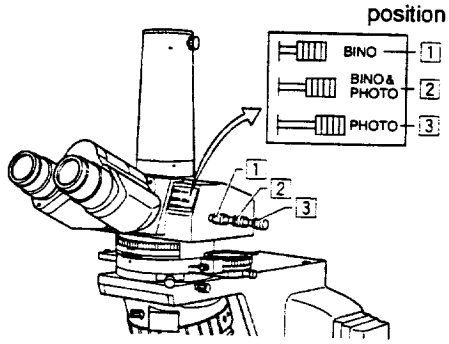
The specimen should be roughly in focus when the stage has been raised as far as it will go; use the fine focus knob to bring the specimen into perfect focus.

If the coarse focus stopper is not being used, be sure to turn the coarse focus stopper ring in the direction opposite to the arrow on the microscope base as far as it will go.

2 Trinocular eyepiece tube

1. Optical path selection

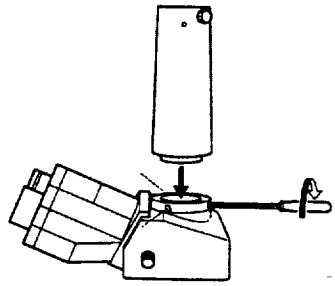
The optical path selection lever can be used to select the way to divide the amount of light between the binocular part and the vertical tube.



Lever position	Light proportion binocular part	:	vertical tube
BINO — 1	100	:	0
BINO& PHOTO — 2	20	:	80
PHOTO — 3	0	:	100

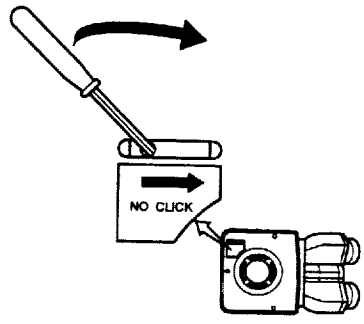
2. Vertical tube adapter

A photomicrographic vertical tube adapter is provided as standard equipment that allows a photomicrographic equipment to be installed. To install the adapter, insert it into the vertical tube and clamp three screws with the provided screwdriver. Replace this adapter with the optional TV vertical tube adapter when using a TV camera.



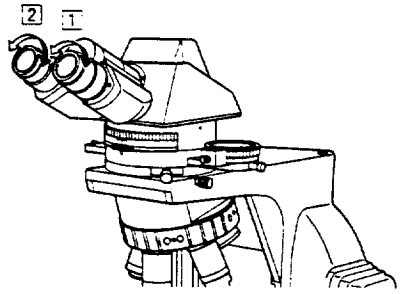
3. Optical path selection lever clicking

There is a switch identified by "NO CLICK" on the bottom surface of the eyepiece tube. Turn the switch in the direction of the arrow with the hexagonal screwdriver provided to disengage the clicking action of the optical path selection lever. Disengaging the clicking action minimizes small vibrations produced by operating the lever.



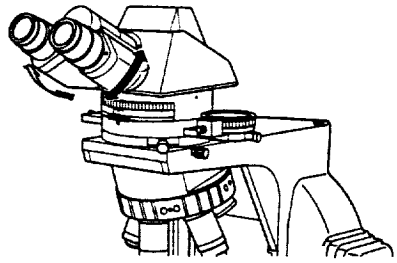
3 Diopter adjustment

The diopter difference between both eyes is adjusted by adjusting the diopter. In the case of a polarizing microscope, since an eyepiece containing crosshairs is used for the right eye, the procedure for adjusting the diopter differs from that of an ordinary microscope. To begin with, turn the diopter adjustment ring on the right eyepiece to bring the crosshairs in the eyepiece into focus [1]. Next, focus on a specimen on the stage while viewing with the right eye, and then turn the diopter adjustment ring on the left eyepiece [2] and bring the specimen into focus.



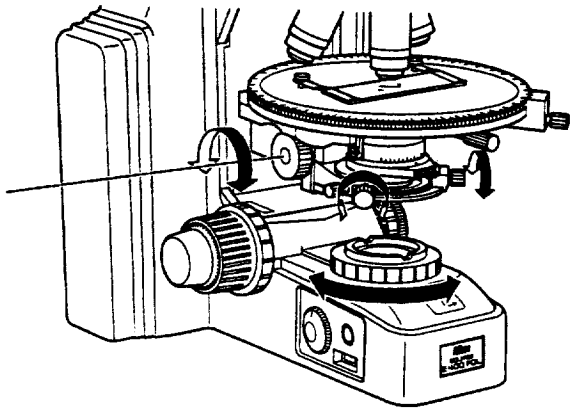
4 Interpupillary distance adjustment

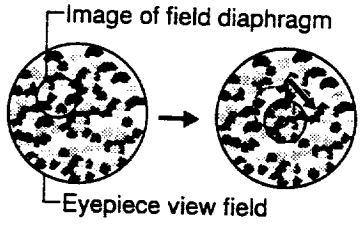
Before adjusting the interpupillary distance, perform steps 1 to 14 in chapter "2 Microscopic Procedure" so that the specimen is in focus with the 10× objective. Adjust the interpupillary distance so that the view field for each eye is at the same position on the specimen. Doing so will make observation through the binocular eyepiece with both eyes easier.

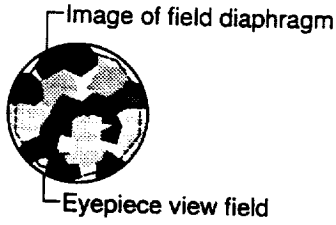


5 Condenser

1. Focusing and centering



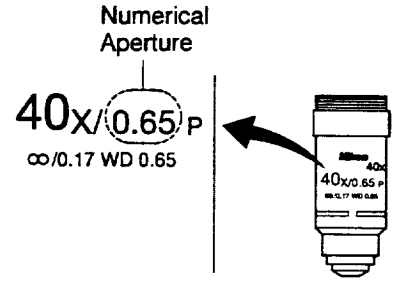


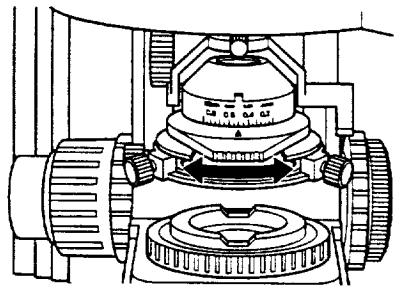


Focus and center the condenser so that the light passing through the condenser forms the image at the correct position on the specimen (i.e., at the center of the optical path).
Before focusing and centering the condenser, perform steps 1 to 15 in chapter "2 Microscopic Procedure" so that the specimen is in focus with the 10× objective.

1. Close the field diaphragm to its minimum setting.
2. Turn the condenser focus knob so that the image of the field diaphragm is formed on the specimen.
3. Make rough adjustments with the condenser centering screws so that the image of the field diaphragm appears at the center of the eyepiece view field.
4. Move the 40× objective into the optical path. Turn the fine focus knob to focus on the specimen.
5. Turn the condenser focus knob so that the image of the field diaphragm is formed on the specimen.
6. Adjust the condenser centering screws so that the image of the field diaphragm appears at the center of the eyepiece view field. This adjustment is easier to make if you adjust the size of the field diaphragm to be slightly smaller than the eyepiece view field.

2. Condenser aperture diaphragm





0.65 x 0.7 ~ 0.8 = 0.455 ~ 0.52

■ Orthoscopic Microscopy

The aperture diaphragm is important because it is related to the resolution, contrast, depth of focus and brightness of the optical image. Turning the condenser aperture diaphragm ring changes the size of the aperture diaphragm.
As the aperture diaphragm is stopped down, resolution and brightness are reduced while contrast and depth of focus are increased. Conversely, as the aperture diaphragm is opened, resolution and brightness are increased while contrast and depth of focus are reduced. It is not possible to adjust one pair of characteristics without affecting the other. Generally, a satisfactory image with appropriate contrast can be obtained with an aperture setting that is 70% to 80% of the numerical aperture of the objective. The numerical aperture is indicated on the barrel of each objective.

An indication of 40×/0.65 means that the magnification is 40× and the numerical aperture is 0.65.

If the aperture diaphragm is stopped down too far, the resolution is reduced; therefore, except when viewing a nearly transparent specimen, we do not recommend stopping down the aperture to less than 60% of the numerical aperture of the objective.

Adjusting the size of the aperture diaphragm according to the condenser scale

Since the condenser scale indicates the numerical aperture, adjust the aperture diaphragm ring according to the scale. (Normally, the index on the aperture diaphragm ring should be aligned with the scale line corresponding to 70% to 80% of the numerical aperture of the objective.)

Adjusting the size of the aperture diaphragm using the Bertrand lens

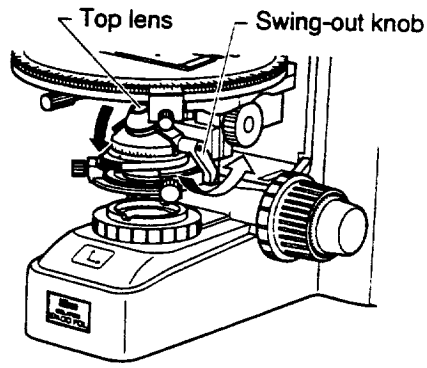
Insert the Bertrand lens into the optical path (by placing in position "B"). Turn the diaphragm control ring to stop down the aperture diaphragm to its minimum setting. Turn the Bertrand lens focus ring to focus on the aperture diaphragm. Turn the diaphragm control ring to adjust the aperture diaphragm. (This is normally adjusted to 70-80% of the field of view.)

■ Conoscopic Microscopy

In the case of conoscopic microscopy, the condenser aperture diaphragm functions as a field diaphragm on the conoscopic image surface. Stop down the diaphragm until it circumscribes the circumference of the field of view of the conoscopic image (pupil of the objective).

3. Swing-out the top lens of the condenser

The top lens of the swing-out condenser can be moved outside the optical path with the swing-out knob.
During normal orthoscopic microscopy or conoscopic microscopy, the top lens is used while positioned in the optical path. During orthoscopic microscopy using a low-power objective of 4× or lower, swing out the top lens.
During measurement of retardation or evaluation by interference color, swing out the top lens (the condenser aperture diaphragm may be stopped down) and illuminate with light that is as parallel to the optical axis as possible.



6 Field diaphragm

The field diaphragm restricts illumination to the area on the specimen being viewed. Turning the field diaphragm ring changes the size of the field diaphragm. For normal observation, the size of the diaphragm should be slightly larger than the boundary of the view field. If a broader area than necessary is illuminated, stray light will enter the view field, creating flaring and reducing the contrast of the optical image. The correct setting of the field diaphragm is especially important in photomicrography; generally, good results are obtained by stopping down the field diaphragm to just slightly larger than the area that will be reproduced on the film, i.e., the size of the photo frame.

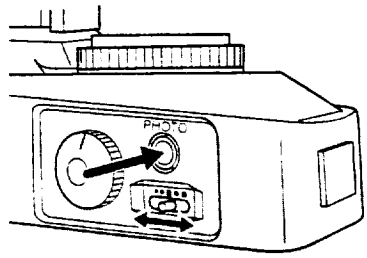
7 Filters

Two filters are available as accessories for this microscope.
Place the filter on the field lens to improve color reproduction or to adjust the brightness.

NCB11 (color balancing filter)	For color balance adjustment and color photomicrography
ND16 (transmission rate: 6%)	For brightness adjustment
GIF (Optional)	For retardation measurement and contrast adjustment (Place on the field lens.)

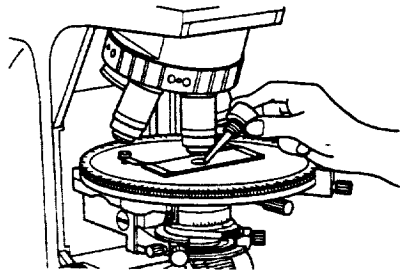
8 Auto-photo switch (for photomicrography)

The color temperature of the lamp varies according to the voltage. If the voltage is high, the color temperature of the lamp increases and the light becomes bluer. If the voltage is low, the color temperature of the lamp decreases and the light becomes redder. Therefore, to obtain the best color reproduction in color photomicrography, it is necessary for the lamp voltage to be kept constant. When using daylight-type color film, the usual setup is to use the color balancing filter (NCB11) and set to the standard lamp voltage.
The auto-photo switch is used to automatically set the standard lamp voltage. If the images on color film shot with the auto-photo switch on are reddish or bluish, finely adjust the voltage with the auto-photo voltage selection switch. The center position of the 5-level slide switch is the standard position. Sliding the switch forward increases the bluish tint of the light, while sliding the switch towards the back increases the reddish tint of the light.
Use commercially available color compensation filters (CC filters) if this adjustment does not resolve the problem.



9 Oil-immersion operation (using an oil-immersion type of objective and condenser)

An objective marked "Oil" is an oil-immersion type. These objectives are used with the immersion oil applied between the specimen and the tip of the objective. The immersion oil is provided for the microscope.



Bubbles in the oil will adversely affect the viewing of the image, so be careful to prevent the formation of air bubbles. To check for air bubbles, remove the eyepieces, fully open the field and aperture diaphragms, and look at the exit pupil of the objective within the eyepiece tube. (The exit pupil will appear as a bright circle.) When it is difficult to see if there are any bubbles, mount a centering telescope (sold separately) on the eyepiece sleeve with an adapter (sold separately). Then, while turning the eyepiece on the centering telescope to change the focus, look through the centering telescope for air bubbles. If there are bubbles in the oil, remove them by one of the following methods:

- Turn the revolving nosepiece slightly, moving the oil-immersed objective back and forth once or twice.
- Add more oil.
- Remove the oil and replace it with new oil.

Use as little oil as possible (just enough to fill the space between the tip of the objective and the specimen). If too much oil is applied, the excess will flow onto the stage.

Any oil remaining on an oil-immersion type of objective or staining on the tip of a dry type of objective has a negative effect on viewing. After using oil, wipe all of it away and make sure that there is no oil on the tips of the other objectives.

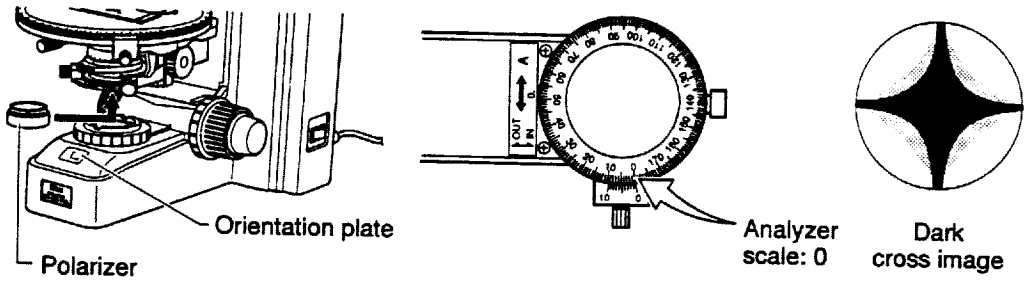
Use petroleum benzine to wipe away immersion oil. Removing the oil and wiping with absolute alcohol (ethyl alcohol or methyl alcohol) will complete cleaning.
If you cannot obtain petroleum benzine, use methyl alcohol. Note that methyl alcohol does not clean as well as petroleum benzine and it will be necessary to repeatedly wipe the surfaces (three or four times is usually sufficient to clean the lenses.)

WARNING When using petroleum benzine or absolute alcohol, always follow the instructions provided by the manufacturer. Keep these flammable liquids away from fire or sparks.

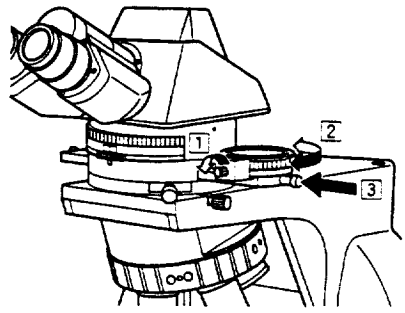
10 Orientation of polarizing plates (Polarizer and Analyzer)

1. Push in the analyzer knob and move the analyzer out of the optical path.
2. Focus on the specimen.
3. Pull out the analyzer knob and move the analyzer into the optical path.
4. Turn the analyzer rotation ring and align at the "0" position on the analyzer scale.
5. Insert the polarizer beneath the condenser.
6. Move the specimen out of the optical path.
7. Move the Bertrand lens into the optical path. The pupil of the objective will then be visible through the eyepiece. Turn the polarizer and adjust so that the dark cross image appears in the pupil as shown in the figure in the conoscopic observation. This is so-called crossed Nicols position, where the directions of the polarizer and analyzer coincide with those of the orientation plate on the top of the microscope base (the polarizer is in the X direction: P and the analyzer is in the Y direction: A).

It should be noted that the X direction is explained as that of the analyzer and Y direction as that of the polarizer in some commercially available technical manuals and reference books.



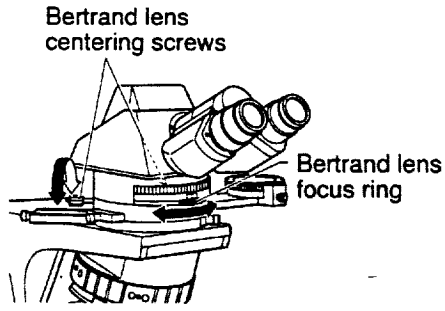
The analyzer can be rotated by first loosening the analyzer clamp screw [1] and then turning the rotation dial [2]. The angle of rotation can be read to 0.1 degrees over a range of 0-360 degrees with the vernier.
The analyzer can be moved out of the optical path by pushing in the analyzer slider [3]. Although the analyzer is designed, as a standard, to be inserted from the right relative to the intermediate tube, it can also be inserted from the left. In this case, it may be somewhat difficult to read the angle of rotation since the readings on the scale, etc. are backward.



Since the intermediate tube contains a built-in depolarizer, it is not necessary to be concerned about the relationship between the orientation of the polarizing plate and photomicrographic devices.

11 Focusing and centering the Bertrand lens

When changing the objectives, turn the Bertrand lens focus ring under the Bertrand lens turret of the intermediate tube and focus the Bertrand lens. Centering the Bertrand lens is performed with two centering screws. The centering procedure is the same as that for the condenser except that the condenser aperture diaphragm image is used instead of the field diaphragm image.



12 P-CL 1/4λ & tint plate

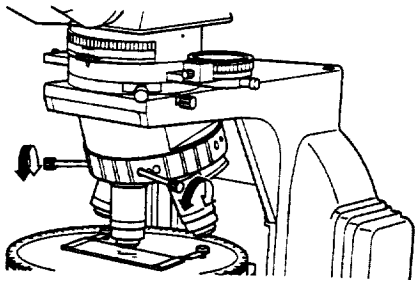
The P-CL 1/4λ & tint plate has a hole in the center. By pushing it into the slot, the sensitive tint plate (530 nm) is brought into the optical path. Pulling it out brings the 1/4λ plate into the optical path. This plate is used for recognition of very weak birefringence and the determination of X' and Y' of the specimen.

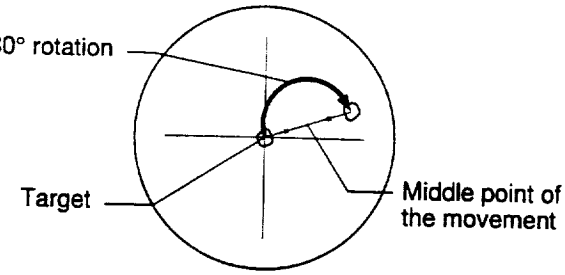
13 Centering the objectives

Before centering the objectives, focus on a specimen using the 10× objective.

Tools Used: Centering tools × 2 (provided) (when not in use, place them in the tool holder in the back of the microscope stand).

1 Bring an appropriate target such as granules that can be easily used as a marker in the specimen to the center of the crosshairs of the eyepiece.
2 Insert the centering tools into the centering screws on the nosepiece.
3 Rotate the stage about 180°. Move the objective using the centering tools so that the center of the crosshairs moves by one-half the amount of movement of the target.
4 Next, move the specimen and bring the target to the center of the crosshairs.
5 Repeat this procedure several times. Carry out this centering procedure for each objective.



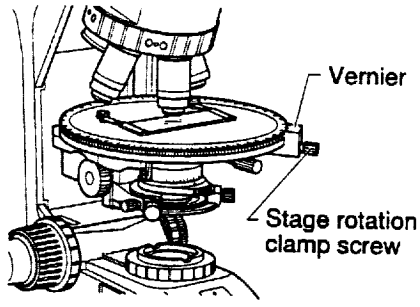


The centering nosepiece has a DIN standard slot. This allows the use of a 1/4λ & tint plate compatible with DIN standards.

14 Circular graduated stage for polarizing microscope

Stage rotation

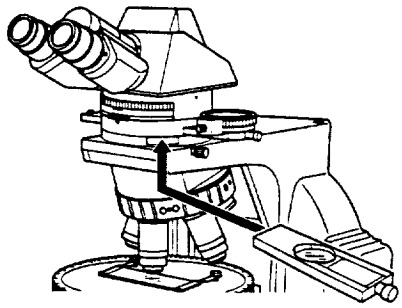
Loosening the stage rotation clamp screw can rotate the stage. The angle of rotation can be read to 0.1 degrees from the two vernier scales.



15 Use of optional accessories (Sold Separately)

1. P-CS Sénarmont Compensator

The P-CS Sénarmont compensator is used by inserting into the slot of the intermediate tube in place of the P-CL 1/4λ & tint plate.
It can be used to measure retardation up to 1λ according to the following procedure.



It is normal to bring the top lens of the condenser into the optical path when observing at a magnification of 10× or greater. Measuring the retardation or evaluating by interference color, however, stop down the condenser aperture diaphragm or swing out the top lens even for a magnification of 10× or higher (with the aperture diaphragm fully opened), and illuminate with light that is as parallel to the optical axis as possible.

1 Determination of Extinction Position

Rotate the stage with the specimen under the crossed Nicols to find the direction where the part of the specimen to be measured appears darkest.

2 Determination of Subtraction Position

Rotate the stage 45° from the extinction position to the diagonal position. Insert the P-CL 1/4λ & tint plate into the optical path and confirm that the interference color of the section of the specimen to be measured changes toward the lower order side. If the interference color changes toward the higher order side, rotate the stage another 90°.

3 Measurement

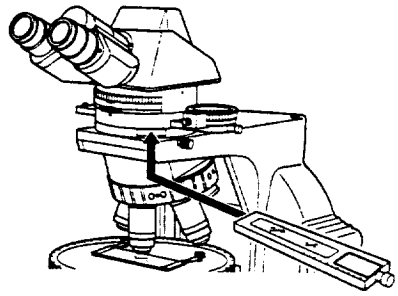
Place the GIF filter on the field lens and replace the P-CL 1/4λ & tint plate with the P-CS Sénarmont compensator. Rotate the analyzer so that the section of the specimen to be measured becomes darkest. When the rotation angle of the analyzer at that time is taken to be theta (θ) degrees, then retardation (R) (nm) is determined with the following formula:

$$R = \frac{\theta}{180}\lambda \quad (\lambda\text{: wavelength used})$$

The value of λ when using the GIF filter is 546 nm.

2. P-CQ Quartz wedge

The P-CQ quartz wedge is used by inserting it into the slot of the intermediate tube in place of the P-CL 1/4λ & tint plate. The quartz wedge is engraved with a scale and can be used for rough measurement of retardation in the range of 1λ-6λ.



It is normal to bring the top lens of the condenser into the optical path when observing at a magnification of 10× or greater. Measuring the retardation or evaluating by interference color, however, swing out the top lens even for a magnification of 10× stop down the condenser aperture diaphragm or higher (with the aperture diaphragm fully opened), and illuminate with light that is as parallel to the optical axis as possible.

1 Determination of Extinction Position

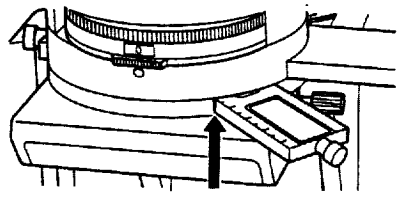
Rotate the stage with the specimen under the crossed Nicols to find the direction where the part of the specimen to be measured appears darkest.

2 Determination of Subtraction Position

Rotate the stage 45° from the extinction position to the diagonal position (direction where the specimen appears brightest). Insert the P-CQ quartz wedge into the slot of the intermediate tube and confirm that the interference color of the section of the specimen to be measured changes toward the lower order side. If the interference color changes toward the higher order side, rotate the stage another 90°.

3 Measurement

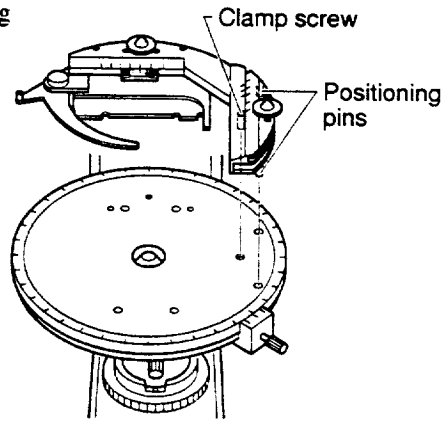
Move the section of the specimen to be measured to the center of the crosshairs of the eyepiece. Next, slide the P-CQ quartz wedge along the slot and observe that the interference color sequentially changes. Stop sliding the quartz wedge where the dark stripe covers the section of the specimen to be measured. Reading the value from the quartz wedge scale at that time can make a rough measurement of retardation.
Retardation can be measured even more accurately by using the P-CS Sénarmont compensator in combination with the P-CQ quartz wedge.



Read the scale

3. Attachable Mechanical Stage

The attachable mechanical stage is installed by inserting the two pins on the bottom into the two pinholes on the stage surface. Tighten the clamp screw using the supplied hexagonal wrench.



4 Assembly

WARNING To prevent electrical shock or fire, turn off the power switch (flip it to the "○" side) during assembly.

CAUTION
- Be careful not to pinch your hands or fingers when setting up the microscope.
- Viewing will be adversely affected if any of the lenses is scratched or has fingerprints on it. Handle the lenses carefully during assembly.
- This microscope is a precision optical instrument. Handle it carefully and do not subject it to a strong physical shock. (The accuracy of the objectives in particular may be adversely affected by even a weak physical shock.)

Assemble each part in sequence as numbered in the diagram. (For details, refer to pages 29 to 33.)

Tools needed

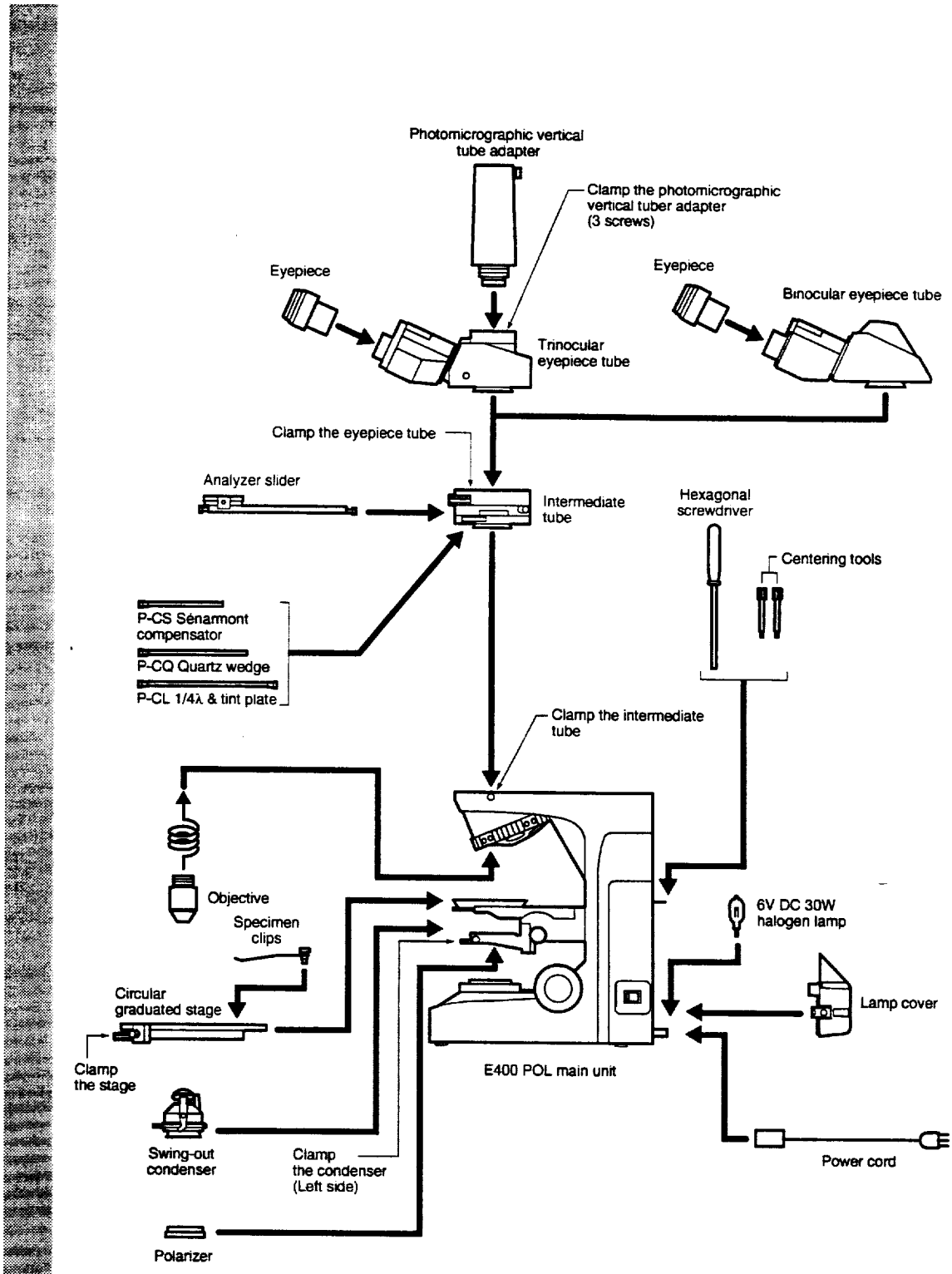
- A hexagonal screwdriver (provided with the microscope) 1.3 mm

When not using, place it in the tool holder in the back of the microscope.

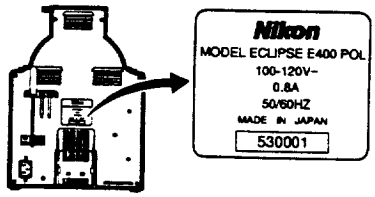
Installation location

This product is a precision optical instrument, and using or storing it under unsuitable conditions may damage it or may have an adverse effect on its accuracy. The following conditions should be kept in mind when selecting the installation location.

- Avoid installing the microscope in a brightly lit location such as a room that receives direct sunlight, or directly under room lights. The quality of the view through the microscope deteriorates if there is excessive ambient light.
- Install the microscope in a location that is free from dust or dirt.
- Install the microscope on a flat surface with little vibration.
- Install the microscope on a sturdy desk or table that is able to bear the weight of the instrument.
- Do not install the microscope in a warm, humid location (environmental temperature: 40°C or higher and relative humidity: 60% or more).


Photomicrographic vertical tube adapter
Clamp the photomicrographic vertical tuber adapter (3 screws)
Eyepiece
Eyepiece
Binocular eyepiece tube
Trinocular eyepiece tube
Clamp the eyepiece tube
Analyzer slider
Intermediate tube
Hexagonal screwdriver
Centering tools
P-CS Sénarmont compensator
P-CQ Quartz wedge
P-CL 1/4λ & tint plate
Clamp the intermediate tube
Objective
Specimen clips
6V DC 30W halogen lamp
Circular graduated stage
Lamp cover
Clamp the stage
E400 POL main unit
Swing-out condenser
Clamp the condenser (Left side)
Power cord
Polarizer

1. Confirming the input voltage



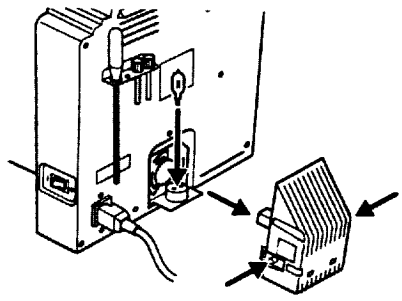
WARNING Make sure that the input voltage indicated on the back panel of the microscope is the same as the voltage provided in your area. If the indicated voltage is different, do not use the microscope and notify your nearest Nikon representative immediately. If the microscope is used with the wrong input voltage, a short circuit, electrical shock or fire may result, causing damage to the microscope.

2. Lamp replacement

CAUTION

- To prevent electrical shock and damage to the microscope, always turn off the power switch (flip it to the "○" side) and unplug the power cord when attaching or removing the lamp.
- To prevent burns, allow the lamp and lamp cover to cool before replacing it for at least 30 minutes after using.
- Use a 6V-30W halogen lamp (PHILIPS 5761).
- Do not touch the glass surface of the lamp with your bare hands. Doing so will cause fingerprints, grease, etc., to burn onto the lamp surface, reducing the illumination provided by the lamp. If you do get any fingerprints or dirt on the lamp, wipe it clean.
- After replacing the lamp, make sure that the lamp cover is attached securely. Never light the lamp while its cover is off.

1. Check that the power switch is off (i.e., that it is flipped to the "○" side).
2. Remove the lamp cover while pressing the buttons on both sides of the lamp cover.
3. Push the lamp into the socket pin holes as far as it will go. (Do not touch the glass portion of the lamp with your bare hands.)
4. Attach the cover securely.



3. Stage assembly

1 Stage

Loosen the stage clamp screw. Place the stage on top of the substage and fit it in position so that it is level. Tighten the clamp screw with the stage clamp screw facing to the front.

2 Specimen clip

Insert the specimen clips into the holes on the stage surface.

3 Condenser

Turn the condenser focus knob to lower the condenser holder as far as it will go.
Insert the condenser in the condenser holder. Tighten the clamp screw on the left side with the aperture scale on the condenser facing to the front.
Turn the condenser focus knob to raise the condenser as far as it will go.
Insert the polarize into the bottom of the condenser.

4. Objective

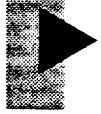
Lower the stage completely. Screw the objective into the revolving nosepiece so that the magnification increases when the nosepiece is rotated in the clockwise direction when looking down on the nosepiece from above.

Note on removing objectives

If there is a specimen on the stage, remove it first. Lower the stage completely, and hold each objective in both hands so that they do not fall when you remove them.

5. Intermediate tube

Completely loosen the intermediate tube clamp screw on the microscope arm. Fit the circular dovetail of the intermediate tube into the circular dovetail groove of the microscope arm by tilting it at an angle. When fitting, insert the positioning pin on the intermediate tube in the receiving groove on the arm. Lock it in position by tightening the clamp screw.



Remove any looseness between the positioning pin and groove by pushing in the intermediate tube while rotating in the clockwise direction.

6. Eyepiece tube assembly

1 Eyepiece Tube

Completely loosen the eyepiece tube clamp screw on the intermediate tube with the hexagonal screwdriver. Fit the circular dovetail of the eyepiece tube into the circular dovetail groove of the intermediate tube by tilting it at an angle. When fitting, insert the positioning pin on the eyepiece tube in the receiving groove on the intermediate tube. Lock it in position by tightening the clamp screw.

Remove any looseness between the positioning pin and groove by pushing in the eyepiece tube while rotating in the clockwise direction.

2 Eyepieces

Attach eyepieces of the same magnification. Attach the eyepiece containing crosshairs on the right side so as to be viewed with the right eye. The sleeve has a positioning pins. Insert the eyepieces by aligning the grooves of the eyepiece with the positioning pins of the eyepiece tube sleeve. Insert the rubber eyegard (sold separately) so that they fit into the grooves around the outside of the eyepieces.

7. Power cord

WARNING Use only the following power supply cord set.

- For 100–120V area
  UL Listed, detachable cord set, 3 conductor grounding type SVT, No. 18 AWG rated at 125V, 7A minimum.
  In case of using the extension cord, use only the power supply cord with the PE (protective earth) wire.
- For 220–240V area
  3 pole power supply cord set, which must be approved according to EU/EN standards.
  Class I equipment should be connected to PE (protective earth) terminal.
  In case of using the extension cord, use only the power supply cord with the PE (protective earth) wire.

Make sure to turn off the microscope power switch (flip it to the "○" side) before connecting the power cord.
Plug the cord into the socket of the AC input connector on the back of the microscope. Securely plug the other end of the cord into an AC outlet.

Covering the tapped holes with protective stickers

The four tapped holes on the upper surface of the microscope arm are for mounting accessories, such as Epi-fluorescence attachment, etc. When not used, cover the tapped holes with the provided protective stickers.

Installing separately sold accessories

Install photomicrographic equipment and other separately sold accessories by referring to the instruction manual for each accessory.

5 Troubleshooting Tables

Improper use of the microscope may adversely affect the performance even if it is not damaged. If any of the problems listed in the table below occur, follow the countermeasures.

1 Viewing and control systems

Problem	Cause	Countermeasure
Vignetting or uneven brightness in the view field; the entire view field cannot be seen.	The optical path selection lever on the trinocular eyepiece tube is in an intermediate position.	Set the optical path selection lever to 100% of the binocular eyepiece. (p.16)
	The optical path selection lever on the trinocular eyepiece tube is not set to 100% of the binocular eyepiece.	
	The revolving nosepiece has not been rotated until it has clicked into place. (The objective is not in the optical path.)	Turn the revolving nosepiece until it clicks into place. (Place the objective in the optical path.) (p.12)
	The condenser is too low.	Position the condenser so that the image of the field diaphragm forms properly on the specimen. (p.18)
	The condenser is not centered.	Center the condenser. (p.18)
	The condenser is not installed properly.	Install the condenser correctly. (p.31)
	The filter is not in the right place.	Place the filter correctly on the field lens. (p.20)
	The field diaphragm is stopped down too far.	Open the diaphragm to a suitable size. (p.20)
	The lamp is not installed properly.	Install the lamp correctly. (p.30)
	The Bertrand lens is in the optical path.	Move out of the optical path.
	The top lens of the swing-out condenser is not positioned properly.	Correctly push in all the way.
	The P-CL, P-CS or P-CQ plate is not inserted correctly.	Position correctly.
Dirt or dust in the view field.	The condenser is too low.	Position the condenser so that the image of the field diaphragm forms properly on the specimen. (p.18)
	The aperture diaphragm is stopped down too far.	Open the diaphragm to a suitable size. (p.19)
	There is dirt or dust on the lens, condenser, eyepiece, filter or specimen.	Clean the components. (p.38)

Problem	Cause	Countermeasure
Viewing is poor (too much or too little contrast, poor resolution).	The aperture diaphragm is stopped down too far.	Open the diaphragm to a suitable size. (p.19)
	The condenser is too low.	Position the condenser so that the image of the field diaphragm forms properly on the specimen. (p.18)
	The cover glass is too thick.	Use the specified type of cover glass (thickness: 0.17 mm).
	There is no cover glass.	
	There is no oil on the tip of an oil-immersion type of objective.	Apply Nikon immersion oil. (p.21)
	The specified immersion oil is not being used.	
	There are bubbles in the immersion oil.	Remove the bubbles. (p.21)
	There is immersion oil on the tip of a dry type of objective.	Clean the components. (p.21)
	The compensation ring on an objective fitted with a compensation ring has not been adjusted.	Adjust the compensation ring according to the cover glass.
	There is dirt or dust on the lens, condenser, objective or specimen.	Clean the components. (p.38)
	A specimen with a cover glass is being observed with an objective for observing specimens without a cover glass.	Use an objective that allows observation of specimens with a cover glass.
	A specimen without a cover glass is being observed with an objective for observing specimens covered with a cover glass.	Use an objective for observing specimens without a cover glass. Mark on the objective ∞/0.17: For observing a specimen with a cover glass ∞/0: For observing a specimen without a cover glass ∞/–: For observing either specimen with or without a cover glass
Uneven focus.	The revolving nosepiece has not been rotated until it clicks into place.	Turn the revolving nosepiece until it clicks into place. (p.12)
	The specimen is not secured in place on the stage.	Install the specimen properly in the specimen clips on the stage.
	The stage has been installed slanted.	Install the stage correctly. (p.31)
Image flows.	The revolving nosepiece has not been rotated until it clicks into place.	Turn the revolving nosepiece until it clicks into place. (p.12)
	The specimen is not secured in place on the stage.	Install the specimen properly in the specimen clips on the stage.
	The condenser is not centered.	Center the condenser. (p.18)
	The stage has been installed slanted.	Install the stage correctly. (p.31)

Problem	Cause	Countermeasure
The image is yellowish.	An NCB11 filter is not being used.	Use the NCB11 filter. (p.20)
	The lamp voltage is too low.	Push auto-photo switch and then adjust the brightness through the ND filter combination. (p.20 and 21)
The image is too bright.	The lamp voltage is too high.	
Inadequate illumination (also check the electrical system problems and countermeasures).	The lamp voltage is too low.	
	The aperture diaphragm is stopped down too far.	Open the diaphragm to a suitable size. (p.19)
	The condenser is too low.	Position the condenser so that the image of the field diaphragm forms properly on the specimen. (p.18)
Focusing is not possible with high-power objectives.	The specimen is placed upside-down.	Set the specimen on the stage with the cover glass facing up.
	The cover glass is too thick.	Use the specified type of cover glass (thickness: 0.17 mm)
The objective strikes the specimen when changing from a low-power objective to a high-power objective.	The specimen is placed upside-down.	Set the specimen on the stage with the cover glass facing up.
	The cover glass is too thick.	Use the specified type of cover glass (thickness: 0.17 mm).
	The diopter setting has not been adjusted.	Adjust the diopter setting. (p.17)
The difference in focus is large when the objective is changed.	The diopter setting has not been adjusted.	Adjust the diopter setting. (p.17)
When viewing through the binocular eyepiece, the image does not resolve into a single image.	The interpupillary distance has not been adjusted.	Adjust the interpupillary distance. (p.17)
	The diopter setting has not been adjusted.	Adjust the diopter setting. (p.17)
Eye strain develops while viewing.	The interpupillary distance has not been adjusted.	Adjust the interpupillary distance. (p.17)
	The diopter setting has not been adjusted.	Adjust the diopter setting. (p.17)
	The brightness level is not suitable.	Adjust the brightness through the ND filter combination. (p.20)

2 Electrical system

Problem	Cause	Countermeasure
The lamp does not light when the power switch is turned on.	The power is not being supplied.	Plug the power cord into an outlet. (p.32)
	The power cord is not connected to the microscope.	Connect the power cord. (p.32)
	The lamp has not been installed.	Install the lamp. (p.30)
	The lamp is burned out.	Replace the lamp. (p.30)
	The specified lamp is not being used.	Use the specified lamp (refer to the electrical specifications on p.39). (p.30)
The lamp flickers; the brightness is unstable.	The lamp is near the end of its life.	Replace the lamp. (p.30)
	The power cord is not connected securely.	Secure the connection. (p.32)
	The lamp is not plugged into its socket securely.	Insert the lamp securely into its socket. (p.30)

6 Care and Maintenance

1 Lens cleaning

Do not let dust, fingerprints, etc. get on the lenses. Dirt on the lenses, filters, etc. will adversely affect the view of the image. If any of the lenses gets dirty, clean it as described below.

- Either brush away dust with a soft brush, or gently wipe away with gauze.
- To remove fingerprints or grease, use a piece of soft, clean cotton cloth, lens tissue, or gauze moistened with absolute alcohol (ethyl alcohol or methyl alcohol).
- Use petroleum benzine to clean off immersion oil (p. 24).
- Do not wipe the entrance lens on the eyepiece tube with petroleum benzine.
- Absolute alcohol and petroleum benzine are both highly flammable. Be careful when handling them, when around open flames, or when turning the power switch on and off.
- Follow the instructions provided by the manufacturer when using absolute alcohol and petroleum benzine.

2 Cleaning painted components

Do not use organic solvents such as alcohol, ether or paint thinner on painted components, plastic components or printed components. Doing so could result in discoloration or in peeling of the printed characters. For persistent dirt, dampen a piece of gauze with neutral detergent and wipe lightly.

3 Storage

Store the microscope in a dry place where mold is not likely to form.
Store the objectives and eyepieces in a desiccator or similar container with a drying agent.
Put the vinyl cover over the microscope after use to protect it from dust.
Before putting on the vinyl cover, turn off the microscope power (flip the switch to the "○" position), and wait until the lamphouse has cooled.

4 Regular inspection

Regular inspection of this microscope is recommended to maintain peak performance. Contact your nearest Nikon representative for details about regular inspection.

7 Specifications and Standards

1. Model Name:	**ECLIPSE E400 POL (microscope main body)**
2. Focusing Mechanism:	• Fine focus knob scale: 1 step equals 1 µm • Amount of movement of fine focus knob: One turn moves the stage up or down by 0.1 mm • Amount of movement of coarse focus knob: One turn moves the stage up or down by about 12 mm • Range of stage vertical motion: 2 mm up and 28 mm down from the reference (focused) position
3. Stage:	• Circular graduated stage with a vernier • Provided with a rotation mechanism with a clamp • Provided with two specimen clips
4. Revolving Nosepiece:	• Fixed on the microscope arm • Quintuple • Provided with an objective centering mechanism
5. Illumination:	• Internal Koehler-type diascopic illumination optics • Provided with a PHOTO switch (5-level fine adjustment selector) • Lamp rating: 6V DC, 30W halogen lamp (PHILIPS 5761)
6. Input Power Supply Voltage:	• AC 100-120V ± 10% 50/60Hz Current consumption: 0.8A or less Internal fuse rating: 250V, T2A • AC 230V ± 10% 50/60Hz Current consumption: 0.4A or less Internal fuse rating: 250V, T2A
7. Protection Class:	Class I
8. Operating Environmental Conditions:	• Temperature: 0 to +40°C • Humidity: 85% RH max., non-condensing • Altitude: 2000 m max. • Pollution: Degree 2 • Installation: Category II • Indoor use only

9. Conforming Standards:

• Product with AC 100-120V

- UL Listed product
- FCC 15B Class A satisfied

This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protections against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which the user will be required to correct the interference at this own expense.

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.
Cet appareil numérique de la Classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

• Product with AC 230V

- GS approved product
- EU Low Voltage Directive satisfied
- EU EMC Directive satisfied

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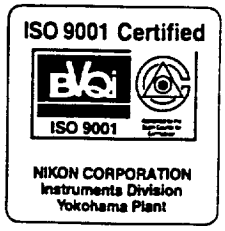

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